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GUIDE LEAFLET

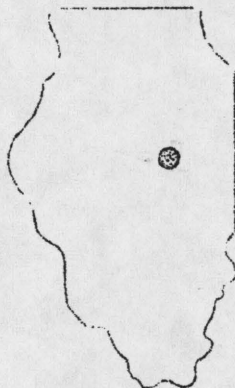
GEOLOGICAL SCIENCE FIELD TRIP

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ILLINOIS STATE GEOLOGICAL SURVEY

PONTIAC AREA

Livingston County

Pontiac and Flanagan Quadrangles



Leaders
Guy Dow, George M. Wilson

Urbana, Illinois
September 28, 1963

GUIDE LEAFLET 1963E

HOST: Pontiac High School

PONTIAC GEOLOGICAL SCIENCE FIELD TRIP

Introduction

The Pontiac area offers an excellent opportunity to study the varied effects of the Wisconsin glacialiation. The relation of glacial lakes and end moraines is of special interest. Abandoned valleys, formed by sub-glacial streams, breached the moraine and later served as outlets for the ponded water. Sand and gravel deposits prevail in these meltwater channels and in the outwash plains and valley trains into which they merge. Several glacial lakes covered hundreds of square miles of Livingston County.

The relationship between available relief and the stage of the fluvial cycle is well illustrated by the Vermilion River which bypassed the youth stage and went directly into maturity.

Limestone provides an important natural resource for the Pontiac area, and many quarries operate in what is probably equivalent to the LaSalle Limestone. In places the limestone is very fossiliferous and there are ample opportunities to collect.

Itinerary

- 0.0 0.0 Assemble in front of Pontiac High School. Proceed west on Indiana Avenue.
- 0.1 0.1 STOP. Turn right (north) on North Main Street.
- 0.1 0.2 Turn left on Mill Street.
- 0.5 0.7 SLOW. Turn right (west) on West Cleary.
- 0.2 0.9 CAUTION. Railroad crossing. (Four tracks)
- 0.3 1.2 STOP. Turn right (north) on Highway 23.
- 0.1 1.3 CAUTION. Bear left on Highway 23.
- 0.2 1.5 STOP. Continue ahead across Highway 66 on Highway 23.
- 0.0 1.5 SLOW. Turn left, then right.
- 0.2 1.7 CAUTION. Railroad crossing.
- 0.1 1.8 SLOW. Curve left.
- 0.2 2.0 Note the broad, flat expanse of the countryside here. This flat terrain is the former bed of glacial Lake Pontiac.

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0.6 2.6 SLOW. T-road west. Bear around to the north.

0.1 2.7 Stop 1. Discussion of nodular Pennsylvanian limestone.

At this locality, we can observe the peculiar nodular character of the limestone that underlies the Pontiac area. Here the nodules have weathered out of the matrix, and unless you look carefully along the edges of the stream where the rock is in place, you would think that these were stream deposited pebbles rather than bedrock. The nodules cropping out here are irregular and rounded, but this formation is extremely variable, and other outcrops have angular fragments like a breccia.

When fresh, this limestone consists of light gray fragments in dark gray limestone matrix. The rock weathers white in places. Actually, only certain beds within this formation have the nodular character.

Geologists are not certain where this limestone fits in the Pennsylvanian stratigraphy. Formerly, it was thought to be equivalent to the LaSalle, but recent studies have produced some uncertainty. It may be Lonsdale (the nodular character is typical of the Lonsdale) but the most diagnostic fossil, *Fusilina acme*, a *Foraminifera* (one celled animal with a hard shell), has not been found. The formation may be Shoal Creek, but this is also uncertain.

This area has been incompletely studied and more work, especially subsurface, needs to be done before geologists can make definite statements about the stratigraphy. These rocks may have undergone some folding and faulting, which further complicates the situation.

The Pennsylvanian Period

Pennsylvanian sediments consist of many different rock types, with coal the most outstanding. In Illinois, coals are commonly overlain by black sheety shale ("roof slate") followed by limestone with marine fossils. The limestone is usually overlain by gray shale also containing marine fossils. Beneath the coal there is an underclay, in turn sometimes underlain by limestone or shale, then sandstone. This type of rhythmic succession of different kinds of strata is repeated in much the same sequence some 50 times where the Pennsylvanian rocks are thickest. Each rhythmic succession of Pennsylvanian rocks is called a cyclothem. An attached sheet shows an ideally complete cyclothem, but all the units are seldom present.

The thickness of the Pennsylvanian System and of the individual cyclothems varies greatly from place to place. An example of this is the interval between the Colchester (No. 2) Coal and the base of the Pennsylvanian. The interval averages about 125 feet in western Illinois, while in the southeastern part of the state this section of the Pennsylvanian geologic column is represented by about 1,200 feet of strata. Although deposition started relatively early in Pennsylvanian time in western Illinois, it either proceeded very slowly or was interrupted frequently by intervals when no sediments were deposited.

The many different rock types in the Pennsylvanian System indicate rapid changes of environment which took place repeatedly. At that time rivers were bringing sediments from the north and east, possibly as far as the present Atlantic coast and the region south of Hudson Bay. The Midwest was a low, flat, swampy area lying just a little above sea level but subjected to frequent marine invasions as the land rose or sank, or the sea level raised or lowered. That these conditions existed is evident from the nature of the sediments. Many of the shales, limestones, and ironstones above the coals contain marine fossils. The coals are believed to have formed in broad freshwater marshes somewhat like the present Dismal Swamp of Virginia. Most of the sandstones, conglomerates, underclays, underclay limestones, and some shales probably accumulated in freshwater environments such as river valleys, lagoons, lakes, or lowland plains. There is no area in the world today that has conditions exactly like those that existed during "Coal Measures" time.

The plants and trees that grew in the Pennsylvanian were very luxuriant. In the jungle-like growths, the plants most common were huge tree ferns that had fronds five or six feet long and grew to a height of more than 50 feet. Along with them were seed ferns, now extinct; giant scouring rushes; and large scale trees, which grew to heights of 100 feet or more.

The large-scale trees preserved in coals do not have growth rings. The luxuriant growth and lack of growth rings probably indicate that the climate that prevailed at this time was warm and without seasonal change. As the plants fell into the swampy waters, they were partially preserved, buried by later sediments, and converted into coal.

- 0.9 3.6 SLOW. Turn left (west). CAUTION. Narrow bridge over Vermilion River.
- 0.6 4.2 We are driving across the flat lake bed of glacial Lake Pontiac.
- 0.1 4.3 SLOW. Turn right (north) on gravel road.

- 0.2 4.5 CAUTION. Winding road along meander curves of the Vermilion River.
- 0.2 4.7 Note the loose nodules of limestone in the river bed. Notice how the Vermilion River has many bends or meander curves throughout its length. Most of the streams in this region are flowing on the bedrock surface and, since their gradient is not steep enough to permit much down-cutting through the solid bedrock, the streams wander back and forth across their flat valleys.
- 0.6 5.3 Note the terraces on the right and left banks of the Vermilion River.
- 0.4 5.7 T-road south. Continue ahead (west) on winding road.
- 0.7 6.4 Note the terrace on the right. This is a different terrace level than the previous terraces.
- 0.6 7.0 T-road north. Continue ahead (west).
- 0.8 7.8 We are still traveling across the site of former glacial Lake Pontiac. It is interesting to note that the Vermilion River and its tributaries are flowing northwestward here. This is primarily because it formerly drained Lake Pontiac to the northwest into the Illinois River. The Inner Cropsey and Chatsworth Moraines guided the Vermilion in its present course.
- 0.8 8.6 CAUTION. Narrow bridge over Rooks Creek. Notice the terrace level on the left.
- 0.5 9.1 Here is a good view of the former bed of glacial Lake Pontiac.
- 1.0 10.1 STOP. Continue ahead (west) across county road.
- 1.4 11.5 CAUTION. Narrow bridge over Scattering Point Creek.
- 0.6 12.1 Crossroad. Turn right (north). The low ridge in the distance to the southwest is the Inner Cropsey Moraine.
- 1.0 13.1 Crossroad. Continue north on gravel road.
- 1.6 14.7 CAUTION. Crossroad. Continue ahead (north).
- 0.1 14.8 CAUTION. Narrow bridge over Short Point Creek.
- 1.4 16.2 SLOW. Crossroads. Continue ahead (north) on blacktop road.
- 1.1 17.3 Bridge over Mole Creek.
- 0.5 17.8 STOP. Turn right (east) on Highway 23.

- 0.1 17.9 Bridge over Mole Creek.
- 1.3 19.2 SLOW. Curve.
- 0.5 19.7 We are now in the valley where Short Point and Scattering Point Creeks join the Vermilion River. You can see gravel deposits on both sides of this stream.
- 0.1 19.8 SLOW. Bridge over Scattering Point Creek.
- 0.3 20.1 Stop 2. Discussion of outwash gravels and Pleistocene stratigraphy in the Vermilion Valley.

Geologically, the Pontiac area offers, among other features, unusual opportunities to study (a) the relation of glacial lakes and glacial moraines and (b) subglacial valleys (sluiceways) created by outlets from the glacial lakes. Sand and gravel deposits prevail in these sluiceways and in other subglacial channels and in the outwash-plains and valley-trains into which they merge. Several glacial lakes covered considerable areas of Livingston County. A review of the glacial history of Illinois will help you to understand the conditions under which these features were formed.

Many thousands of years ago most of Illinois, together with most of northern North America, was covered by huge glaciers. These glaciers expanded from centers in central and eastern Canada. They developed when the mean annual temperatures were somewhat lower than now, so that not all of the snow that fell during the winters melted during the summers. The snow residues accumulated year after year. A sheet of ice was formed so thick that, as a result of its weight, it began to flow outward, carrying with it the soil and rocks on which it rested and over which it moved. The process continued until the glacier extended into the Midwest as far south as the Missouri and Ohio Rivers.

Moderation of temperatures halted the glacier. For a while the melting of the ice balanced its accumulation and expansion, so that its margin remained stationary. Later the melting exceeded the accumulation and expansion, and the ice-front gradually melted back until the glacier disappeared entirely.

There were four major glaciations during the Pleistocene Epoch or "Great Ice Age." Between each was a long interglacial period in which conditions were much as they are today. During each major glaciation there were a number of retreats and re-advances. This was particularly true during the last or Wisconsinan glaciation.

A complete discussion of Pleistocene history would require a sizable volume. In fact, the story is still not fully known. Present facts indicate that this part of geologic history began about one million years ago when the Nebraskan glacier advanced over the area. This first glacier is named Nebraskan because the typical Nebraskan glacial deposits are best developed in the state of Nebraska. Nebraskan deposits are not abundant in Illinois probably because weathering during the Aftonian (interglacial) Age after the retreat of the Nebraskan glacier destroyed them.

The next glacial episode produced the Kansan glacier which again advanced from the west. Thick deposits of till and outwash sand and gravel were deposited in Illinois when the Kansan glacier melted away.

The Kansan Age was followed by the Yarmouthian (interglacial) Age, during which erosion carved valleys and hills in the Kansan deposits.

The third glaciation, the Illinoian, is important to the residents of Illinois. It covered 80 percent of Illinois, reaching southward to Carbondale and Harrisburg. In contrast to the preceding glacial advances, the Illinoian came from the east rather than the west.

After several thousands of years, climatic conditions caused the melting away of the Illinoian ice sheet. During this warm age, the upper part of the Illinoian till was weathered and soils developed, just as during the preceding Yarmouthian interval. However, this weathering was not as intense as it was during the Yarmouthian, and the post-Illinoian (Sangamonian) interval is estimated to have lasted only about 150,000 years. The Sangamon Soil resembles present day soils in color, texture, and depth of development. This fact lends support to theory that the climate existing during interglacial times was similar to the present climate. The theory that we are living in an interglacial interval has been advocated by numerous glacial geologists. They estimate that a drop of only five degrees in the average annual temperature would bring another glacier down upon us.

The last of the Pleistocene glaciers, the Wisconsinan, began its advance from the Lake Michigan Basin into Illinois some 70,000 years ago. The first pulse advanced into northwestern Illinois and an unknown distance south, and as it melted and retreated, a drift was deposited--the Winnebago. After the first major pulse, the glacier retreated northward beyond the borders of Illinois, and then about 22,000 years ago a second pulse of the Wisconsinan glacier moved south and west to the present sites of Shelbyville, Peoria, and Fulton.

As the Wisconsinan glacier retreated, withdrawals and readvances created a complex sequence of deposits in northeastern Illinois, the most striking of which are the end moraines. More than fifty separate end moraines were formed by this glacier in Illinois alone. The major ones are shown on the accompanying glacial map of northeastern Illinois.

As the glaciers melted, they released all of the soil and rocks which they had picked up as they advanced. Some of this material or drift was deposited in place as the ice melted. Such material consists of a thorough mixture of all kinds and sizes of rocks and is known as till. Some of the glacial drift was washed out with the melt-waters. The coarsest outwash material was deposited nearest the ice-front and gradually finer material farther away. Much of the finest clay was carried all the way to the ocean. Where the outwash material was spread widely in front of the glacier it forms an outwash-plain; where it was restricted to the river valleys it forms valley trains.

To appreciate the significance of the Pleistocene history and its effects on the inhabitants of Illinois, we need to consider only the rich soils formed from the glacial deposits, and the abundant deposits of sand and gravel of glacial origin in our state. We definitely would not have these if the glaciers had missed Illinois.

The section in the gravel pit here at Stop 2 is as follows:

Topsoil, brown, some pebbles, silty in upper portion	2 - 3 inches
Brown, deeply weathered gravel	3 - 5 feet
Gravel, silty in places, medium to fine grained	2 - 12 feet
Gray, sticky, till with few pebbles	bottom of pit

Because of the numerous gravel deposits within the Vermilion Valley, geologists believe that this channelway carried large quantities of melt water from the Chatsworth and Marseilles glaciers. The melt water was laden with drift, and the coarser sand and gravel was deposited close to the ice front while the fine silt and clay sized particles were carried farther away. This sorting action produced the more or less clean sand and gravel deposits which have been commercially developed for road building and construction purposes. This outwash deposit is not a broad continuous sheet or outwash plain such as often develops in front of end moraines. Here the gravels are confined to the valley and are called a valley train deposit by Pleistocene geologists.

We are located close to where the Marseilles Moraine overrides the Chatsworth Moraine, and consequently, the gravel may be associated with either or both tills. Here the gravel is brown, but only $\frac{1}{4}$ of a mile to the northwest the gravel is distinctly light gray and finer grained.

The Pleistocene history of this region is further complicated by the former existence of two glacial lakes which will be fully discussed at Stop 6. There are no lake deposits in this pit except possibly a very thin Lake Pontiac silt on top of the weathered gravel. The reason for this is apparent from a glance at the topographic map. This valley is the lowest elevation in the area and probably served as the outlet of Lake Pontiac and also for the final stages of Lake Ancona. The water increased in velocity as it was funneled through the outlet valley, carrying away the fine sediments.

The Cropsey till (the Cropsey Moraine lies 6 miles to the southwest) underlies the outwash gravel. The upper portions of the till have been weathered. Apparently the till was not covered by Lake Ancona immediately upon being uncovered by the melting Cropsey ice sheet. Lake Ancona probably started as numerous localized ponds which eventually coalesced to form one large lake. This process left many portions of the newly deposited Cropsey till exposed to weathering for some time.

- 0.6 20.7 Bridge over the Vermilion River.
- 1.4 22.1 Entering the village of Cornell. Speed limit 40 miles per hour.
- 0.3 22.4 Speed limit 30 miles per hour.
- 0.1 22.5 CAUTION. Railroad crossing.
- 0.1 22.6 SLOW. Turn right (south).
- 0.1 22.7 CAUTION. Railroad crossing.
- 0.1 22.8 SLOW. School on right.
- 0.9 23.7 Bridge over Ida Creek.
- 0.7 24.4 CAUTION. Curve right.
- 0.1 24.5 Stop 3. Weathering profile on glacial till underlain by Pennsylvanian limestone.

The following sequence is exposed in this ravine:

Loess mixed with humic matter, black to grayish black.	6" zone A
Brown Loess, oxidized and leached of carbonates.	15" zone B ₁
Silt and pebble zone, oxidized.	1½" zone B ₂
Gray to brownish gray till	12' zone C
Pennsylvanian limestone, nodular, brecciated light nodules is dark gray matrix.	3-5' exposed

Of particular interest at this stop is the loess overlying the Cropsey till and the soil profile developed upon them.

Anyone visiting a region where glaciers are active has noticed the milky color of the melt water as it flows away from the ice front. This glacial "milk" results from the suspended load of fine silt and clay sized particles. The great glaciers of the Pleistocene produced huge volumes of melt water that flowed down the major river valleys depositing countless tons of this fine-grained material. At times, especially in the winters, the outwash plains and valley trains were exposed and dried as the melt waters subsided. Strong winds, partially the prevailing westerlies and partially anticyclonic circulation around the high pressure area over the cool ice mass, picked up the silt and fine sand from these surfaces. The material was blown across the country and dropped to form deposits called loess. Glacial loess mantles most of Illinois. Near the large river valleys, it may be as much as 60 to 80 feet thick. Far from the valleys, it may be measured only in inches, if it can be identified at all.

The loess exposed here was deposited on Cropsey till during and after the retreat of the glacier.

Like many other things, rocks and minerals change when they are exposed to the weather. Although these changes are relatively slow, they become evident in earth deposits that are not disturbed over long periods of time, and may develop a weathering or soil profile in the surficial part of such deposits.

Following the practice established about 30 years ago by the Russian Glinka, soil scientists usually consider that the soil or weathering profile consists of 3 zones, designated A, B, and C from top down. The A zone is the "soil" zone, which is normally black or gray in color. The B zone is the "subsoil" zone, and the C zone is the unaltered parent material.

The zonal effect is due to the four principal processes which effect soil weathering, all progressing downward with the movement of groundwater, but at different rates. These processes, listed in order according to their rate of progress beginning with the most rapid, are (1) oxidation, (2) leaching of carbonates, (3) decomposition of more resistant minerals, and (4) accumulation of humus.

Consequently, in the A zone, in which the humus material derived from decaying plants has accumulated, the rock minerals are oxidized, leached, and decomposed. In the upper part of the B zone they are oxidized and leached, and in the lower part of the B zone they are only oxidized. The oxidation zone is shown by the reddish or yellowish color resulting from the oxidation of iron minerals. The leached zone is determined by the absence of carbonates, as revealed by tests with a solution of hydrochloric acid.

The soil zones are shown in the accompanying geologic section. Actually, the lower B zone probably extends further into the till, but slumping has made it impossible to determine this accurately without auger borings some distance away from the cut face.

Beneath the Pleistocene deposits is the same Pennsylvanian limestone that underlies the rest of the field trip area. Here the individual nodules are more firmly cemented together than at Stop 1. Notice the irregular patches of ground up shells on some of the weathered surfaces. This is known as a fossil hash. A definite joint or fracture pattern also has developed within this rock. Such a regular pattern suggests that some external forces have been active in the region and may have produced folding or faulting of the originally horizontal bedrock strata. This would account for the inability of geologists to completely establish the age and distribution of the limestone on the basis of outcrops alone. The need for subsurface work is apparent.

- 0.1 24.6 CAUTION. Y-road. Bear left.
- 0.1 24.7 CAUTION. Turn left (east).
- 0.1 24.8 Till on right and left.
- 0.1 24.9 SLOW. Bridge over nameless creek.
- 0.1 25.0 Note till in roadcut on left.
- 1.3 26.3 SLOW. Turn right (south).
- 0.1 26.4 CAUTION. Bridge over Baker Run. This bridge has a 5-ton limit.

- 0.3 26.7 The Marseilles Moraine is barely visible in the distance to the left, looking east, and to the southeast can be seen the Chatsworth Moraine.
- 0.5 27.2 Bridge over small, nameless creek.
- 0.1 27.3 Crossroad. Continue ahead (south).
- 0.9 28.2 Bridge over Wolf Creek.
- 0.2 28.4 SLOW. Turn left (east).
- 0.0 28.4 Bridge over Wolf Creek.
- 1.5 29.9 SLOW. Entering settlement of Rowe. Continue east.
- 0.3 30.2 CAUTION. Railroad crossing.
- 1.0 31.2 Note the ridge of the Marseilles Moraine several miles to the northeast.
- 0.2 31.4 STOP. Turn right (south) on Highway 23.
- 0.3 31.7 Bridge over Wolf Creek.
- 1.5 33.2 CAUTION. Railroad crossing.
- 0.0 33.2 Stop 4. Quarry of the Pontiac Stone Co. Discussion of Pennsylvanian limestone, black shale, 2 inch coal seam, and an underclay.

Add one mile to the itinerary for the trip down into quarry and out again.

Pennsylvanian Marine Limestone

At the top of the excavation there are about 5 feet of buff clay containing sand, pebbles, and boulders. This is glacial till, deposited by the Wisconsin glacier which existed here less than 50,000 years ago.

The glacial till rests on limestone bedrock which constitutes the quarry stone. The stone, crushed to different degrees of fineness, is used chiefly for road stone, concrete aggregate, and agricultural lime.

About 12 feet of limestone is exposed above the quarry floor, which is underlain by gray to white to buff, more shaly limestone containing abundant fossils.

Where ditching cuts down through the quarry floor, it reveals the lowest limestone layer which is granular and made up of ground-up remains of shells, crinoids, etc. A thin layer of blue clay separates this limestone from a black "slaty" shale which is the lowest rock exposed in the vicinity.

The black shale is about $2\frac{1}{2}$ feet thick and is underlain by a 2 inch coal seam. Beneath the coal is an underclay of unknown thickness because the bottom is not exposed. The black shale is easily split into thin sheets and on the surface of some of these sheets may be seen tiny flecks glistening in the sunlight. These flecks, upon magnification, prove to be conodonts. Conodonts are small, jaw-bone shaped structures with a row of sharp, pointed teeth on one end. They are not really teeth because they are never dull or worn. Consequently, paleontologists believe they are some sort of internal supports of a small animal. No one knows what the animal looked like because the rest of it is never preserved. This is undoubtedly because the body consisted only of soft parts which were easily destroyed.

The limestone is probably the LaSalle Formation of Pennsylvanian (Coal Period) age. Beneath this limestone are other Pennsylvanian strata down to a distance of 500 feet below the surface. Most of this 500 feet thickness is shale, but there are also layers of sandstone, limestone, and coal. The shale was deposited as mud, the sandstone as sand, and the coal as peaty, half-decayed vegetation.

Abundant fossils of sea life in the limestone show that the rock formed in marine water which was clear and shallow. Most abundant here are brachiopods, especially smooth-shelled Composita and small, rough-shelled Marginifera, but many other types of shells occur, along with crinoidal remains, small cup corals (Lophophylum profundum) and bryozoa of both the lacy (Fenestella) and branching types.

Like other Pennsylvanian limestones in Illinois, this one is relatively thin indicating that the sea invasions were short-lived here.

Coal in Livingston County

In the past, coal was mined from a depth of between 170-225 feet at various places in the Pontiac region. The seams varied from 23 to 76 inches in thickness and have been called No. 7, No. 5, and No. 2 Coals. More than one seam of minable coal may occur in the area. Most geologists believe that the coal of greatest commercial importance in the county was the No. 7.

- 1.4 34.6 CAUTION. Railroad track.
- 0.1 34.7 STOP. Highway 66. Continue across 66 on 23.
- 0.2 34.9 STOP. Turn right (south) on Highway 23.
- 0.3 35.2 STOP. Turn right (east) on Highway 116 through Pontiac.
- 0.1 35.3 CAUTION. Railroad crossing. Five tracks.
- 0.4 35.7 CAUTION. Traffic signals.
- 0.1 35.8 CAUTION. Traffic signals.
- 0.2 36.0 SLOW. Turn right (south) on Riverview Drive.
- 0.1 36.1 SLOW. Cross Madison Avenue.
- 0.1 36.2 STOP. Continue ahead on Riverview Drive across East Water Street.
- 0.1 36.3 CAUTION. Curve. Continue on Riverview Drive.
- 0.2 36.5 SLOW. Enter Pontiac City Park.
- 0.1 36.6 Stop 5. Lunch. Discussion of stream and valley cycles (geomorphic cycle) and flood plain features of the Vermilion River.

Newly uplifted or newly formed land surfaces, whether they are folded mountains, glacial till plains, lake plains, loess blankets, uplifted fault blocks, etc., are subject to sculpture and reduction by the various agents of erosion. The progress of this erosion, from beginning to completion and then reinitiation after renewed uplift of the region, has been termed the "Geomorphic Cycle" and was first systematized and defined during the late 19th Century by William Morris Davis, the father of American geomorphology. The significance of this "cycle" and the concepts involved are filled with subtleties and complexities and could not possibly be intelligently discussed in a publication of this size. However, the system breaks down to one largely dependent upon the development of stream valleys.

Stream valleys are classified as young, mature, or old depending upon characteristics developed at different stages in their evolution. The words young, mature, and old refer to successive stages of development and do not necessarily have time connotations.

One characteristic of youthful valleys is a "V" shape. The stream fills the valley from wall to wall, and the divides between the streams are broad and flat. The stream is actively down-cutting rather than broadening its valley.

Mature streams have cut down high points and built up low points throughout their courses and their valleys have become more or less graded. A graded stream is one in which the gradient is such that the stream can just carry the load supplied to it. Mature streams develop meanders and floodplains, and their valleys are at least as wide as their meander belt. The interstream divides have been cut down so that they are sharp-ridged and entirely in slope. Downcutting is at a minimum, and most of the energy is used up in lateral cutting of the valley walls. Drainage is at maximum development as evidenced by the well integrated tributary system.

Old streams have valleys several times the width of their meander belts, and floodplain features are at maximum development. The divides have been reduced to low, widely separated individual hills. Drainage is sluggish and tributaries are few in number.

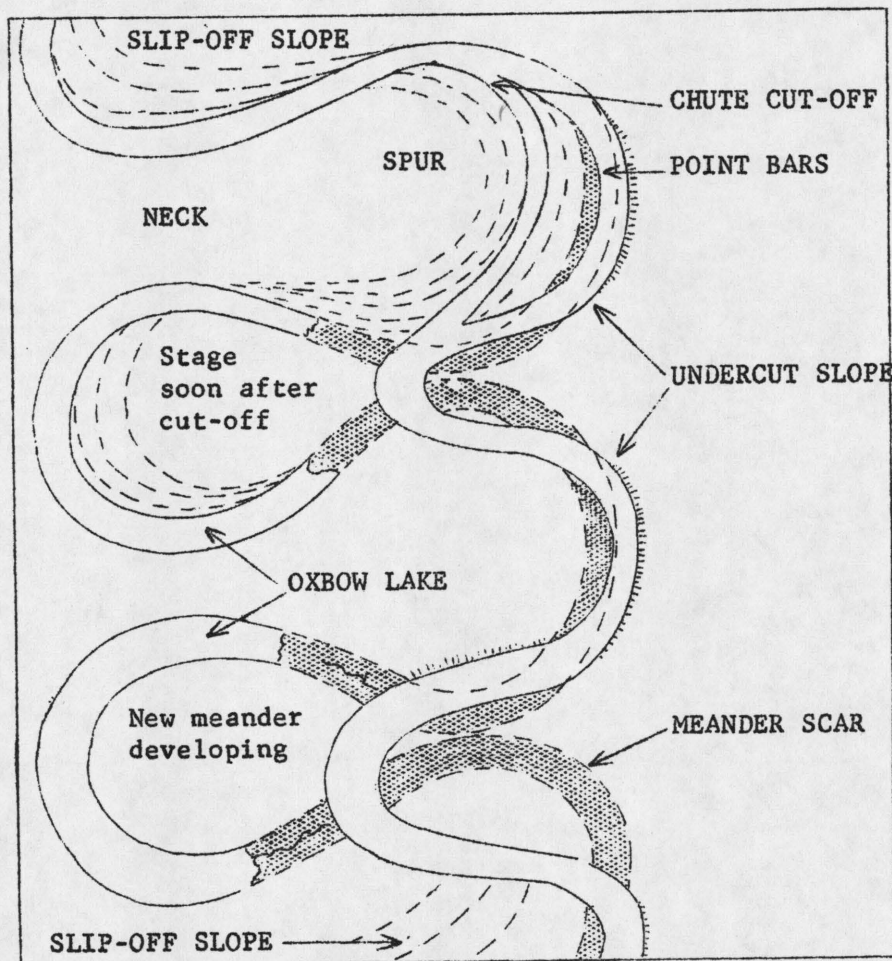
Most of the streams on the newly exposed Wisconsinian till plain are young, but the Vermilion River is in early maturity, having developed a floodplain, meanders, and oxbow lakes along its course. This can be explained by the concept of available relief.

This concept, in simplest terms, means that if the original relief available to the stream is insufficient for normal evolution, the stream may go directly from inception to maturity without passing through the youthful stage at all.

Available relief is the vertical distance from the head of the stream to base level. Base level is the lowest level to which a stream can cut down and still maintain a gradient or slope along its course. For example, sea level would be the ultimate base level of a stream. However, most streams (except the large ones that flow directly to the ocean) are controlled by local base level. The largest stream in a given area generally establishes a temporary base level for its tributaries. Likewise, a lake formed within the course of a stream serves as a local base level. Resistant rock strata also may establish a temporary, local base level.

Water flowing through a meander curve (see illustration) is forced against the outside bank called the cut, or undercut bank. As the cut bank is eroded back, the channel migrates in this direction leaving a slip-off slope on the inside of the curve. Deposition of material may occur on the slip-off slope in crescent shaped forms which, when incorporated into the flood-plain, become flood plain scrolls. Meanders move across the valley and also downstream. Abandoned meanders generally leave evidence of existence in the form of meander scars. The area within a meander

curve is called the spur and the narrow portion is called the neck. At times of high water the river may cut off the meander through the neck leaving a meander core. If water is left in the cut-off meander, it is called an oxbow lake. When the river cuts through channel bars or point bars, which form on the slip-off slope, a chute cut-off is formed.



Floodplain features

During floods great quantities of material (especially the coarser material) is deposited when the river suddenly loses its velocity as it goes over the banks. This material piles up, forming ridges or natural levees along the stream banks. The remaining material is spread out over the valley floor forming a flood-plain.

Each time that the river floods, the levee is built higher, but at the same time the river bottom is built up to match the increased height of its banks. When a levee breaks through at an isolated point, the break is called a crevasse. Water flowing through a crevasse quickly loses velocity upon debouching upon the flood-plain and forms a fanshaped deposit. The escaping stream is broken up into several branching channels which spread the sediment into a fan.

After Lake Pontiac had completely drained, the Vermilion River soon cut through the thin unconsolidated lake sediments and took a meandering course across the old lake flat not far above the Illinois River, the local base level for the Vermilion. As the water level of the Illinois was lowered further, the Vermilion was rejuvenated and entrenched itself into the bedrock. However, several stationary levels in the Illinois Valley interrupted its downward cutting. Despite the Vermilion's small volume, these temporary base levels gave it time to erode narrow flats, remnants of which remain as terraces. As many as four terraces are present at various localities. The topographic map plainly shows the entrenched meanders, especially in the lower reaches of the Vermilion.

Pontiac City Park is situated within a meander spur of the Vermilion. If the river is allowed to continue its lateral cutting, it will cut the park off completely and leave a meander core.

- 0.5 37.1 STOP. Leaving Pontiac City Park. Turn right (east) then left (north) on Forest Street.
- 0.3 37.4 STOP. Turn right (east). CAUTION. Railroad crossing. Continue east on Water Street.
- 0.5 37.9 SLOW. T-road. Turn left (north).
- 0.2 38.1 STOP. Turn right (east) on Highway 116.
- 0.7 38.8 SLOW. Leave Highway 116 and continue ahead on blacktop road.
- 0.5 39.3 SLOW. Turn left (east).
- 0.2 39.5 SLOW. Turn right (south).
- 0.1 39.6 SLOW. Turn left (east) on T-road. We are now gradually ascending the front slope of the Chatsworth Moraine. Note the rolling swell and swale topography.
- 0.6 40.2 Note the flat lake beds of glacial lakes Pontiac and Ancona to the right.
- 0.7 40.9 CAUTION. Crossroads.

- 0.6 41.5 We are now on the crest of the Chatsworth Moraine.
- 0.4 41.9 Note the low crested ridge of the Marseilles Moraine to the north-east and also, eight or nine miles away, straight to the east. Turn right (south).
- 0.7 42.6 Stop 6. Discussion of Wisconsin moraines and glacial lakes.

Here you are on the outer crest of the Chatsworth Moraine. The Marseilles Moraine is obstructed from view at this point. From this vantage point, the lake beds of glacial lakes Pontiac and Ancona are best viewed. Far to the south is the low crested ridge of the Inner Cropsey Moraine.

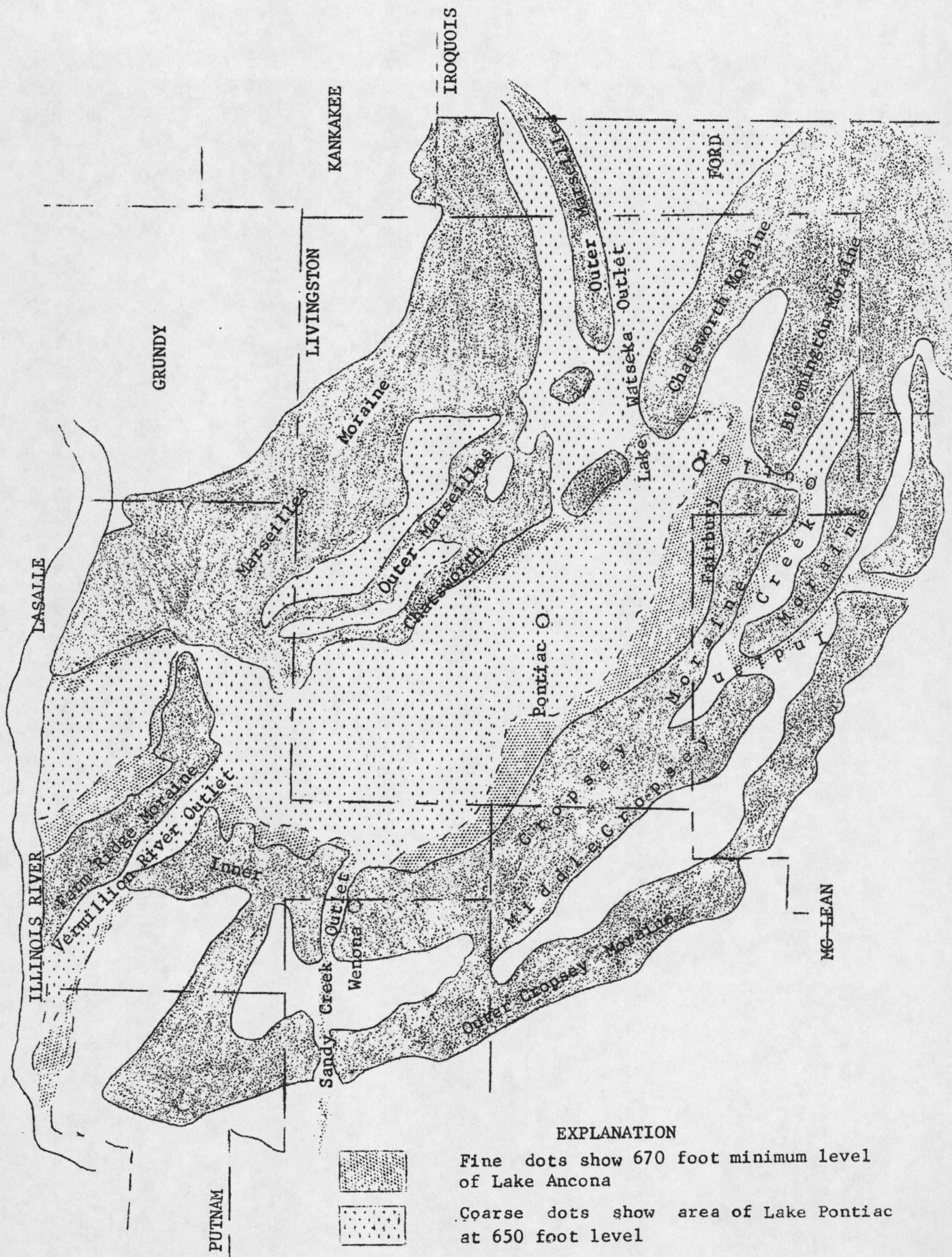
As shown on the map in the back of the guide leaflet, there are several moraines of Wisconsin age in Illinois. The Shelbyville Moraine marks the maximum southward advance of the Wisconsin glacier. Each of the other moraines marks the position to which the ice front readvanced after a recession of unknown distance from the position it had previously attained.

The surface relief of moraines is generally greater than that of the drift plains. It is generally referred to as swell-and-swale, but on some moraines it is termed knob-and-kettle topography. Generally, the outer slope and edge of the moraines is interrupted by valleys and reentrants marking the courses of glacial rivers. At some places gaps are in the moraines where subglacial streams presumably carried away most of the drift. Subglacial valleys may be distinguished from valleys developed by erosion in post-glacial time by the fact that morainic topography occurs all the way down the valley slopes.

The Chatsworth Moraine is a narrow ridge which lies close to the Marseilles. In places, the Marseilles Moraine overlaps onto the back slope of the Chatsworth. As will be seen, the Chatsworth figured prominently in the glacial history of the Pontiac region.

The Inner Cropsey Moraine is one in a series of three moraines, which also include the Outer and Middle Cropsey. The subcrests of these moraines are not equally distinguishable or equal in magnitude at all places. South of Fairbury the Outer and Middle Cropsey Moraines are both narrower than the Inner, and the Middle Moraine, on which the town of Cropsey is located, is higher and more prominent than either the Outer or Inner Moraines.

As the glacier began to recede, meltwater accumulated in local ponds or small lakes between the icefront and the moraine last formed, except where there were channels through the moraine through which water could drain. Where such drainage channels were absent, as the icefront continued to recede, the local ponds and lakes gradually merged into one large lake. This lake persisted until the glaciers uncovered some passage or until some outlet river eroded a channel through which it could drain.



Geological studies show that such a lake, or a series of lakes, existed behind each of the three Cropsey Moraines. It has not been determined whether the older ones still existed or were drained before the later ones developed. However, for a time, the waters of the lake that locally existed behind the Inner Cropsey Moraine flowed out southward through a gap in the moraine, a gap which is now part of the valley of Indian Creek southwest of here.

The existence of Lake Ancona between the Inner Cropsey Moraine and the receding front of the glacier that built it has already been mentioned. The lake has been named Ancona after a small town in northwestern Livingston County.

As in the case of all such lakes, the first stage of Lake Ancona was the appearance of a number of ponds and lakes between the ice front and the moraine. These ponds and lakes had no uniform level, but were controlled strictly by local circumstances. As the ice front receded, the ponds and lakes merged into larger and larger units, until eventually there was one large lake.

In the early and intermediate stages of their development, the various units of the lake had individual outlets. The present valley of Indian Creek through the Inner Cropsey Moraine was the outlet for the portion that first covered the Fairbury area. The highest elevation of this outlet has not been determined, but it must have been at least 680 feet and was probably nearer 700 feet above mean sea level.

Outlets of other units of the lake were westward through the moraine by way of Sandy Creek and some of its tributaries in the vicinity of Wenona. Because it was lower than any of the other outlets, the Sandy Creek outlet became the one and only outlet when the lake completely unified. For a time it determined the elevation of the lake at 670 feet above mean sea level. However, the outflowing waters eroded the outlet to a width of nearly a mile and down almost to 650 feet above sea level before the receding ice front apparently opened up an outlet along the Vermilion River near Lowell that was so low that Lake Ancona presumably completely disappeared.

Waves and currents in a lake as large as Lake Ancona tend to smooth its bottom by eroding off the tops of the elevations and depositing the resulting detritus in the depressions. Consequently, in the portion of the Inner Cropsey drift plain that was covered by the early higher stages of Lake Ancona, the relief is more subdued than in the portion that was not so covered, and the portion that was covered by the semipermanent lake is almost flat. On the basis of these differences, it appears that at its earliest stage the lake must have stood at an elevation of almost 700 feet above mean sea level. During its semipermanent stage, it must have stood at a maximum of approximately 670 feet above mean sea level. Its boundary at this stage is shown on the map.

The lake is underlain by Inner Cropsey till deposited as the glacier melted back. On top of this till are deposits of silt, sand, and gravel washed out from the glacier as it receded. On top of these deposits are laminated lacustrine silts. No other lacustrine deposits, such as marl and laminated clays, have been noted. Possibly none may have been deposited because the lake existed relatively so short a time. In places, as at Stop 9, lake silts rest directly upon the tills. The overlying outwash gravel is from the Chatsworth glacier.

Lake Pontiac

The position of the Wisconsin glacier fluctuated as it melted back with readvances interrupting its gradual retreat into the Lake Michigan basin. In the vicinity of Chicago it formed the Valparaiso Moraine. Glacial Lake Chicago formed between the Valparaiso Moraine and the ice of the Lake Michigan Lobe. Lake Chicago was the ancestor of the present Lake Michigan. The Valparaiso glacier melted rapidly and the Illinois Valley at times could not contain the tremendous volume of water flowing into it from the outlet river which had breached the Valparaiso Moraine.

The resulting flood is called the Kankakee Torrent or Kankakee Flood. At its maximum extent, some of the flood water flowed south through the Iroquois River Gap in the Marseilles Moraine and flooded the Iroquois basin to a level of approximately 660 feet, reviving former Lake Watseka. The revived Lake Watseka in turn overflowed westward into the north fork of the Vermilion River. This overflow, combining with backwater from the flood in the Illinois valley, formed glacial Lake Pontiac. This expanse of water spread over the Illinois-Vermilion Valley, up to an elevation of approximately 650 feet above mean sea level, covering hundreds of square miles (see fig. 2).

- 0.3 42.9 CAUTION. Crossroads. Continue south.
- 1.0 43.9 SLOW. T-road. Turn left (east).
- 0.4 44.3 Note the swell and swale topography on the crest of the Chatsworth Moraine to the left.
- 1.2 45.5 STOP. Turn right (south) on blacktop road.
- 0.9 46.4 Entering the valley of the North Branch of the Vermilion River. This is the former outlet of glacial Lake Watseka.
- 0.2 46.6 Stop 7. A bridge over north branch of the Vermilion River. Discussion of Lake Watseka outlet.

Problems in logistics made it impossible to plan the stops so that they would occur in the proper order to correspond with the complicated chronological succession of glacial lakes. We have discussed the formation of Lake Ancona and Lake Pontiac. Concurrent with the formation of Lake Pontiac was the revival of Lake Watseka. The first Lake Watseka formed after Lake Ancona and prior to Lake Pontiac.

Just as Lake Ancona was developed behind the Inner Cropsey Moraine, so a large lake was developed between the Chatsworth Moraine and the receding front of the Chatsworth glacier.

In its earliest stages this lake (Lake Watseka) drained through four outlet channels, all essentially at the same elevation between 700 and 710 feet above mean sea level in the vicinity of Hoopeston, and down North Fork Wabash-Vermilion River. As the ice-front receded, it uncovered near Buckley a lower outlet for the lake at an elevation about 670 feet above sea level through the Chatsworth Moraine to Illinois-Vermilion River to the west. The outlets near Hoopeston were consequently abandoned. Later it exposed a still lower westward outlet at an elevation of 650 feet above sea level near Onarga. Both the Buckley and Onarga outlets led to the main westward outlet which we are viewing and which is now the valley of North Branch Illinois-Vermilion River.

Presumably Lake Watseka was completely drained when the Chatsworth glacier uncovered the Kankakee River Valley. However, it must have been revived to the 650-foot level when the Marseilles glacier readvanced and again blocked Kankakee Valley. It was again revived when the Kankakee Torrent, derived from the Valparaiso glacier, flooded Kankakee and Illinois Valleys. Erosion of the Illinois-Vermilion outlet at all of these times made a valley almost two miles wide down to an elevation of approximately 650 feet above mean sea level. This same "sluiceway" valley appears to continue down the Illinois-Vermilion Valley. The broad flat valley bottom of Indian Creek may be related to this stage, as the depth of the Vermilion River Valley would determine the depth to which Indian Creek could erode.

Immediately across the outlet valley is the Chatsworth Moraine. To the left is the Outer Marseilles Moraine and close behind it, with only an intramorainal sag one to two miles wide between, is the main Marseilles Moraine. Through these moraines there are numerous subglacial valleys, along which there are considerable deposits of outwash. Several of these outwash-bearing subglacial valleys are tributary to the outlet valley.

- 1.4 48.0 SLOW. Turn right (west) on gravel road.
- 0.3 48.3 Abandoned gravel pit on right.
- 0.5 48.8 Note gravel pit on left.
- 0.1 48.9 Note piles of dredgings from the Vermilion River on right.
- 0.3 49.2 Stop 8. Discussion of bedrock, lake silts, glacial till, and glacial outwash gravels in the valley of the Vermilion River. This stop is at the junction of the Lake Watseka outlet and glacial Lake Pontiac.

This gravel pit is located where the westward outlet river of Lake Watseka joins glacial Lake Pontiac (see fig. 2).

The gravel in this pit is probably outwash from the Chatsworth glacier, which lay to the northeast across the Illinois-Vermilion River, although there is a possibility that it is outwash of Cropsey age deposited as the Inner Cropsey glacier receded. It lies on till that is Cropsey in age. It has a wide range in size, including boulders, and contains some pebble-armored till balls, which are thought to indicate deposition not far from the ice front. The gravel is overlain by silt, which may represent in part outwash and in part lacustrine deposits of Lake Pontiac.

The beds are dipping slightly and may be part of a deltaic structure formed in Lake Pontiac. The location of the gravel in the outlet of Lake Watseka also suggests that it may be a channel deposit.

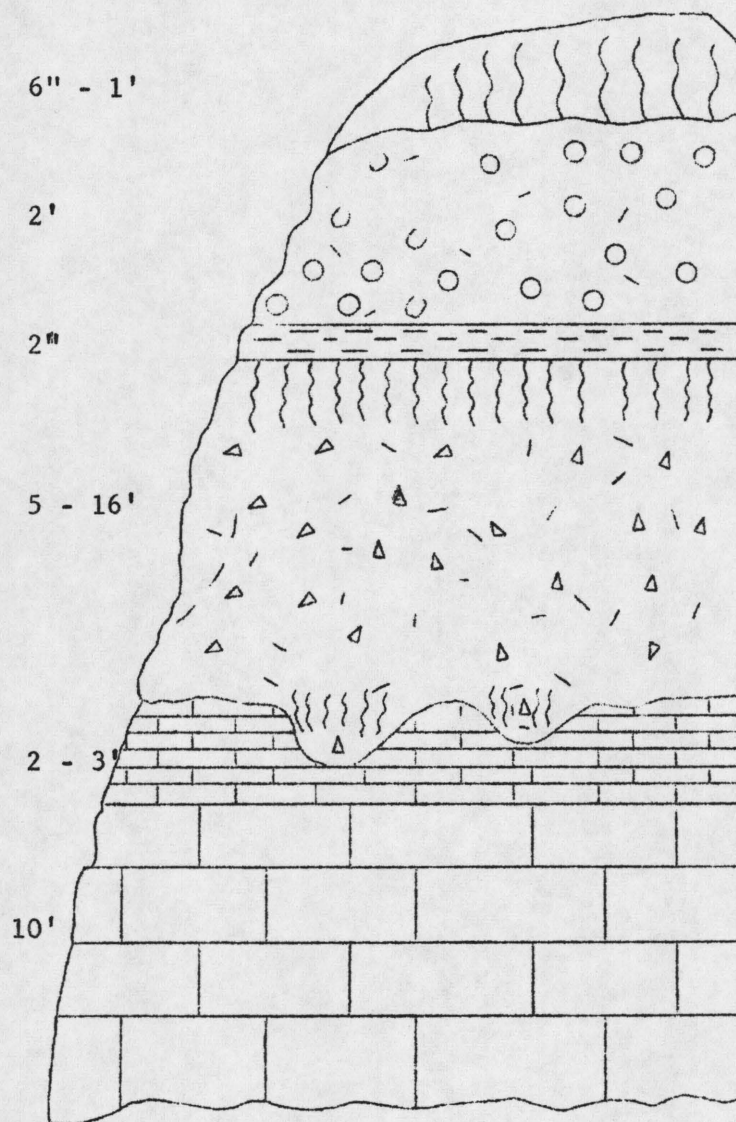
It is interesting to compare the weathering profile developed here on the silt and gravel with the one that is developed on loess and till at Stop 3. Here the oxidized zone extends to water level several feet below the surface, and in openings in the upper part of the gravel there is clay that has been carried down by groundwater.

Exposure of Glacial Deposits and Pennsylvanian Bedrock

Not far east of the approach to the bank of the channel there is an excellent exposure of a succession, from the top down, of silt, sand and gravel, laminated silt, and fresh till, presumably of Cropsey age. Elsewhere sand and gravel and silt may be seen under this till.

Farther east the LaSalle Limestone (?) and the overlying green, purple, and red shale of the LaSalle Cyclothem are exposed in the banks and bottom of the river. The irregular exposure of the limestone may be due either to lenticular distribution or to small local folds. Much of the limestone has been faceted, polished, and striated by the glaciers which have overridden it. Some fossils occur in the limestone. The bedrock is overlain by glacial deposits, generally sand and gravel overlain by till.

- 0.4 49.6 Note the dredgings from the Vermilion River on right. The dredgings consist mostly of till and some fragments of the Pennsylvanian limestone. These dredgings were conducted to straighten out the river and give it better drainage.
- 0.0 49.6 T-road. Turn left (south).
- 0.4 50.0 T-road. Turn right (west).
- 0.2 50.2 We are now crossing at the approximate minimum level of glacial Lake Ancona. The strand line trends northwest-southeast. Lake Ancona lies to the northeast of this strand line.
- 0.8 51.0 T-road. Turn left (south).
- 0.2 51.2 CAUTION. Railroad crossing.
- 0.3 51.5 Crossroads. Turn right (west).
- 0.6 52.1 CAUTION. Narrow bridge.
- 0.1 52.2 We are now driving across the former lake bed of glacial Lake Ancona.
- 0.3 52.5 CAUTION. Crossroads. Continue ahead on blacktop road.
- 2.1 54.6 STOP. Turn left (south).
- 0.2 54.8 CAUTION. Livingston Stone Co. quarry on left and right. This quarry is in the same Pennsylvanian limestone seen at previous stops. The bedrock here lies at a depth of about 5 feet.
- 0.8 55.6 SLOW. Turn right (west) on gravel road.
- 1.1 56.7 CAUTION. Crossroads. Continue ahead.
- 1.0 57.7 CAUTION. Crossroads. Continue ahead (west).
- 0.9 58.6 SLOW. Narrow bridge over Rock Creek. Notice the nodular limestone in the creek bed. Bridge has a 5-ton limit.
- 0.5 59.1 Bumpy bridge.



Deeply weathered gravel in places may be topped with lake silt.

Gravel, medium grained, silty in places.

Finely laminated lake silts.

Till, upper 1 foot has weathering profile.

Lower portion of till in sinks and channels in limestone may be different till than upper part. Hint of weathering profile at this level.

Limestone, 2-3' beds, weathers buff; ankeritic or sideritic. Very crystalline and fossiliferous.

Limestone, non-iron bearing, otherwise similar to unit above. In places this rock is brecciated like others in area in the lower 6" to 12".

Figure 3. Section in Chenoa Stone Co. Quarry

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0.3 59.4 SLOW. Turn right into the yard of the Chenoah Stone Co. quarry.

0.3 59.7 Stop 9. Quarry of the Chenoah Stone Co. in Pennsylvanian limestone.

Pleistocene Section

Unlike the other Pleistocene stops, here there is a lake silt immediately above the Cropsey Till. This was probably deposited during a high stage of Lake Ancona. The gravel may be outwash from the retreating Cropsey ice or it may be from the Chatsworth glacier. The top of the gravel has a soil profile which may in part be developed upon overlying silts from Lake Pontiac. However, Lake Pontiac is not known to have reached this elevation. The Cropsey till has a weathering profile or fossil soil zone at the top. This indicates that some time elapsed between the withdrawal of the Cropsey glacier and the inundation by Lake Ancona. The till in the depression of the limestone surface also has some indications of a weathering profile on it, making it an older till than the Cropsey.

Bedrock Section

Here the limestone is slightly different than that seen at previous stops. The top 2-3 feet is thinly bedded and weathers buff because of ankerite or siderite. This upper zone is the most fossiliferous. The best place to collect is in piles of the buff material on the floor of the quarry. The underlying 10 feet of limestone consists in part of nodular or brecciated rock but is more crystalline than the rocks seen elsewhere on the trip. It occurs in beds from 6 inches to 1 foot thick.

Limestone quarrying is an important industry in the Pontiac area. The stone is used mostly for road material and agricultural lime. The stone in this quarry does not contain many clay partings which would lower its value.

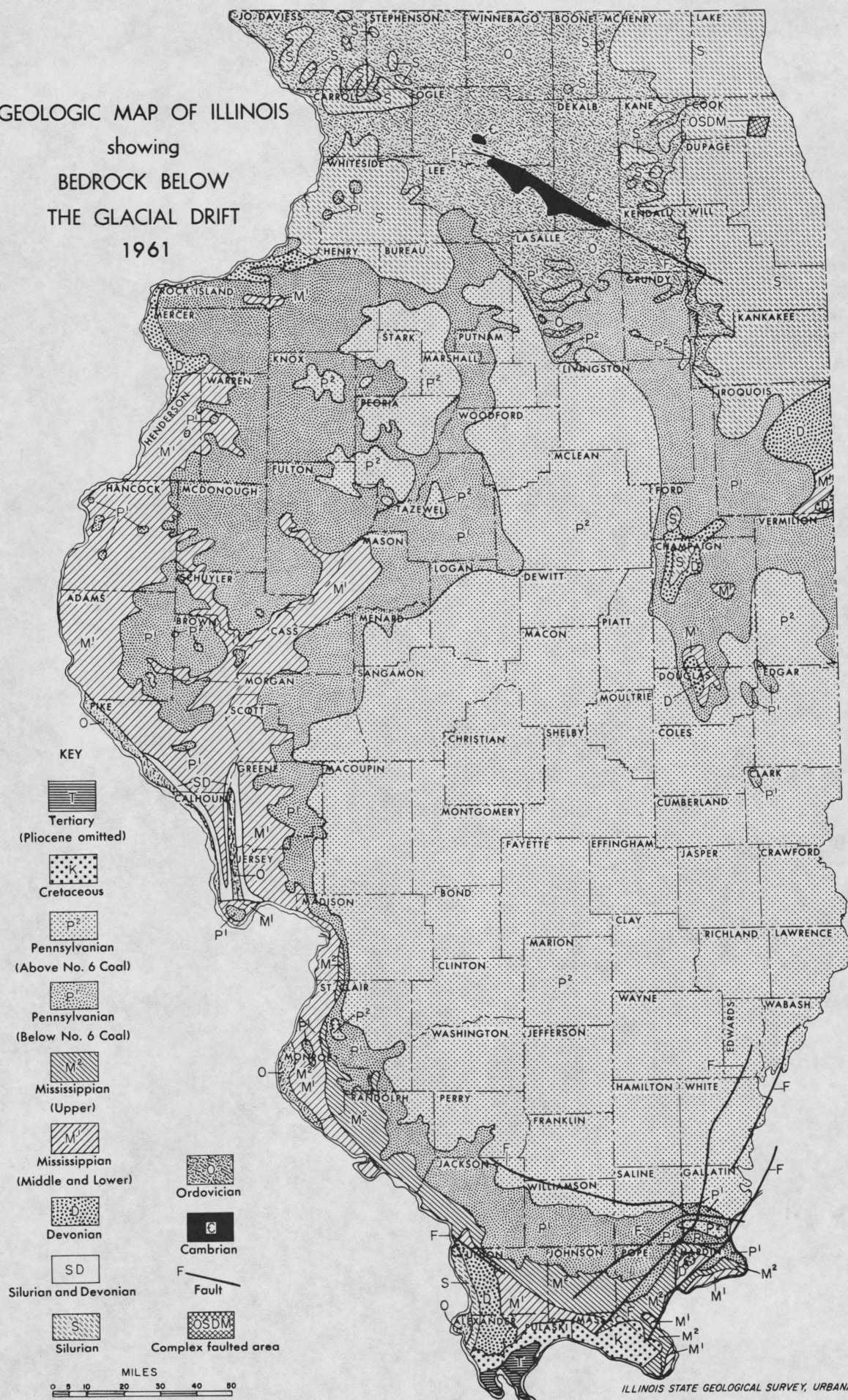
End of Field Trip

Revised and Reprinted, September, 1966.

GEOLOGIC COLUMN IN PONTIAC AREA

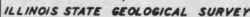
Era	Sys-tem	Series	Group or Stage	Formation	Material
CENOZOIC	Pleisto-				Wisconsinan till, gravel, sand, and lake clays and silts
	cene				
	Ter-tiary				Not present
PALEOZOIC	Pennsyl-		McLeansboro		Sandstone, shale, clay, limestone, No. 2, 6, and 7 Coals
	vanian		Kewanee		
	Missi-	Kinder-			Shale, brown
	ssip-	hookian			
	pian				
	Devon-				Limestone, light gray
	ian				
	Silurian	Niagaran		Port Byron Racine Waukesha Joliet	Dolomite and (or) some limestone
		Alexandri-		Kankakee Edgewood	Dolomite and sandstone
	Ordovician	Cin-	Maquoketa		Shale and some dolomite or limestone
		cinnatian			
		Champlain-	Galena		Dolomite and (or) limestone, light brown
			Platteville	Decorah	Dolomite and (or) limestone with streaks of shale
			Ancell	Glenwood St. Peter	Dolomite and (or) limestone
				Sandstone, shale, and dolomite Sandstone, sometimes conglomeratic at base	
Canadian			Shakopee	Dolomite with some thin sandstone beds	
	Prairie du Chien	New Richmond	Sandstone and some dolomite		
	Oneota		Dolomite, usually cherty.		
Cambrian	St. Croixan	Trampealeau-		Dolomite, sandstone, and shale Dolomite	
		Franconia		Sandstone, dolomite, and shale; very glauconitic	
		Dresbachian		Sandstone with some dolomite Sandstone, shale, and dolomite Sandstone, arkosic in lower part; some shale and conglomerate	
Pre-Cambrian				Crystalline rocks	

GEOLOGIC MAP OF ILLINOIS
showing
BEDROCK BELOW
THE GLACIAL DRIFT
1961



TIME TABLE OF PLEISTOCENE GLACIATION
(after J. C. Frye and H. B. Willman, 1960)

STAGE	SUBSTAGE	NATURE OF DEPOSITS	SPECIAL FEATURES
RECENT	Years Before Present	Soil, youthful profile of weathering, lake and river deposits, dunes, peat	
	5,000		
	Valderan 11,000	Outwash	Outwash along Mississippi Valley
	Twocreekan 12,500	Peat and alluvium	Ice withdrawal, erosion
WISCONSINAN (4th glacial)	Woodfordian	Drift, loess, dunes, lake deposits	Glaciation, building of many moraines as far south as Shelbyville, extensive valley trains, outwash plains, and lakes
	22,000		
	Farmdalian 28,000	Soil, silt and peat	Ice withdrawal, weather- ing, and erosion
	Altonian	Drift, loess	Glaciation in northern Illinois, valley trains along major rivers, Winnebago drift
SANGAMONIAN (3rd interglacial)	50,000 to 70,000	Soil, mature profile of weathering, allu- vium, peat	
ILLINOIAN (3rd glacial)	Buffalo Hart	Drift	Glaciers from northeast at maximum reached Mississippi River and nearly to southern tip of Illinois
	Jacksonville	Drift	
	Liman	Drift, loess	
YARMOUTHIAN (2nd interglacial)		Soil, mature profile of weathering, allu- vium, peat	
KANSAN (2nd glacial)		Drift Loess	Glaciers from northeast and northwest covered much of state
AFTONIAN (1st interglacial)		Soil, mature profile of weathering, allu- vium, peat	
NEBRASKAN (1st glacial)		Drift	Glaciers from northwest invaded western Illinois

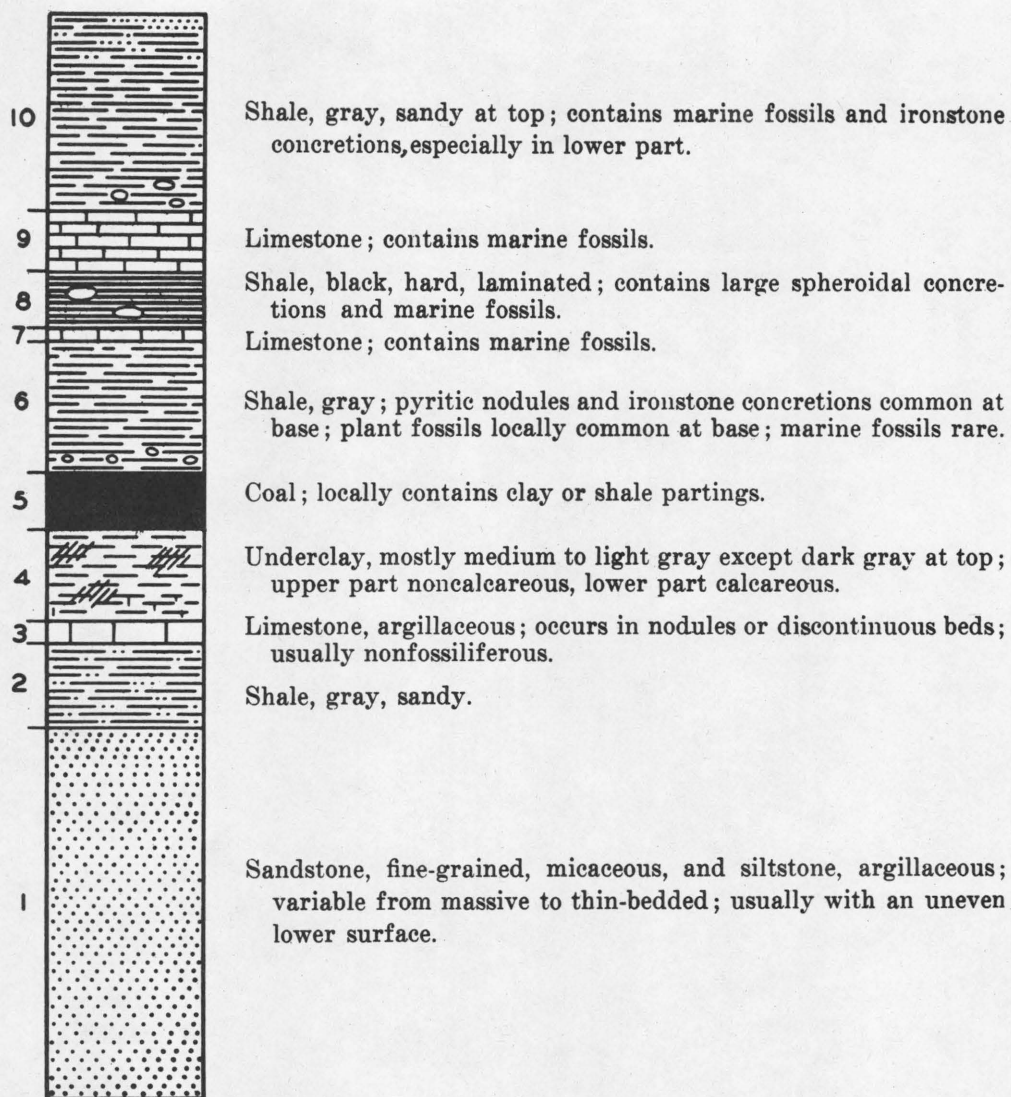


Revised 1960



PHYSIOGRAPHIC DIVISIONS OF ILLINOIS

(Reprinted from Illinois State Geological Survey Report of Investigations 129, "Physiographic Divisions of Illinois," by M. M. Leighton, George E. Ekblaw, and Leland Horberg)



AN IDEALLY COMPLETE CYCLOTHEM

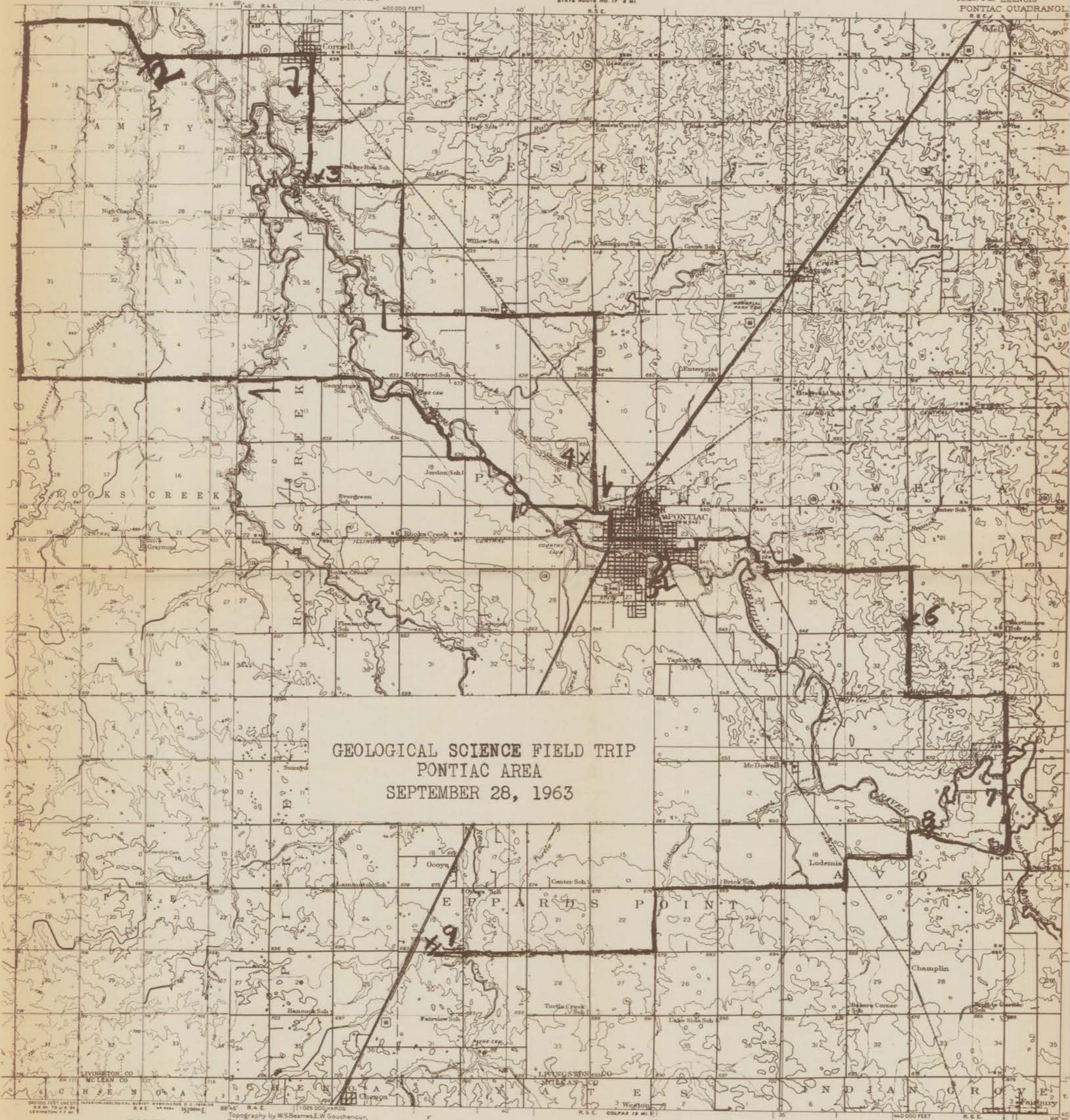
(Reprinted from Fig. 42, Bulletin No. 66, Geology and Mineral Resources of the Marseilles, Ottawa, and Streater Quadrangles, by H. B. Willman and J. Norman Payne)

FLANAGAN QUADRANGLE
ILLINOIS
15 MINUTE SERIES (TOPOGRAPHIC)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

STATE ROUTE NO. 17 - 8 MI.

JULIET 28 MI.
PONTIAC QUADRANGLE



GEOLOGICAL SCIENCE FIELD TRIP
PONTIAC AREA
SEPTEMBER 28, 1963

ROAD CLASSIFICATION
Heavy duty ———
Light duty - - - - -
Medium duty - - - - -
Unimproved dirt - - - - -
State Route

Topography by W.S. Beames, E.W. Gouchenour,
F.W. Weber and R.V. Henderson
Surveyed in 1935
LEXINGTON 28 MI.
BLOOMINGTON 24 MI.

Scale 1:25,000
1 inch = 2,000 feet
1 mile = 1,609.3 meters
1 kilometer = 0.62137 miles
1 nautical mile = 1.15078 statute miles
1 statute mile = 1.60934 kilometers
1 nautical mile = 1.852 kilometers

Contour interval 10 feet
Datum is mean sea level

ROADS IMPROVED SURFACES
ROADS OTHERWISE SURFACES
1935
UNITED STATES ROUTE NUMBER
STATE ROUTE NUMBER

Polyconic projection, North American datum
5000 yard grid based on U.S. zone system, C
10000 foot grid based on Illinois (East)
rectangular coordinate system
ANCHOR 14 MI.

PONTIAC, ILL.
Edition of 1939

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N4045-W8845/15